

WHAT IS CLAIMED IS:

1. A method of separating components of a mixture, the method comprising:

providing a mixture of particles, the mixture comprised of at least a first group of particles and a second group of particles, the first group of particles having a different chemical composition than the second group of particles;

exposing the mixture of particles to microwave/millimeter wave energy in order to differentially heat the first and second group of particles, thereby increasing the difference in magnetic susceptibility between the first and second group of particles; and

exposing the mixture of particles to a magnetic field gradient, the magnetic field gradient causing the particles to separate into first and second fractions, the first fraction having a greater percentage of the first group of particles than the mixture, and the second fraction having a greater percentage of the second group of particles than the mixture.

2. The method of claim 1, wherein the mixture of particles is a lateritic ore.

3. The method of claim 1, wherein the first group of particles includes one or more metal values.

4. The method of claim 3, wherein exposing the mixture of particles to microwave/millimeter wave energy further comprises heating at least a portion of the first group of particles to approximately the Néel temperature of one of the metal values.

5. The method of claim 3, wherein the first group of particles includes one or more nickel values.

6. The method of claim 1, further comprising a third group of particles that includes one or more cobalt values.

7. The method of claim 1, further comprising contacting the mixture of particles with a gas.

8. The method of claim 1, further comprising fluidizing the mixture of particles.

9. A method of concentrating nickel values of a lateritic ore, the method comprising:

providing a lateritic ore comprised of a mixture of particles;
exposing the lateritic ore to microwave/millimeter wave energy in order to selectively heat particles that contain substantial amounts of one or more nickel values, thereby increasing the difference in magnetic susceptibility between the particles that contain substantial amounts of nickel values and particles that contain insubstantial amounts of nickel values;

exposing the lateritic ore to a magnetic field gradient, causing at least some of the particles that contain substantial amounts of nickel values to separate from the mixture of particles.

10. The method of claim 9, wherein the nickel values are nickel oxides.

11. The method of claim 9, wherein exposing the mixture of particles to microwave/millimeter wave energy further comprises heating at least a portion of the particles that contain substantial amounts of nickel values to approximately the Néel temperature of at least one of the nickel values.

12. The method of claim 9, wherein exposing the mixture of particles to microwave/millimeter wave energy further comprises heating at least a portion of the particles that contain substantial amounts of nickel values to a temperature of at least about 150°C.

13. The method of claim 9, wherein exposing the mixture of particles to microwave/millimeter wave energy further comprises heating at least a portion of the particles that contain substantial amounts of nickel values to a temperature of at least about 250°C.

14. The method of claim 9, further comprising contacting the mixture of particles with a gas.

15. The method of claim 9, further comprising fluidizing the mixture of particles.

16. An apparatus for separating components of a mixture of particles, the apparatus comprising:

a vessel having an interior for containing the mixture of particles during processing;

an energy system coupled to the vessel for exposing the mixture of particles to microwave/millimeter wave energy; and

a magnetic separator communicating with the interior of the vessel for separating magnetic particles from non-magnetic particles.

17. The apparatus of claim 16, further comprising a gas distributor for contacting the mixture of particles with a gas.

18. The apparatus of claim 16, further comprising a gas distributor for fluidizing the mixture of particles.

19. The apparatus of claim 16, further comprising a second vessel having an interior in communication with the magnetic separator.

20. The apparatus of claim 19, further comprising a gas distributor for contacting particles contained in the interior of the second vessel with a gas.

21. The apparatus of claim 20, further comprising a source of gas in fluid communication with the gas distributor, wherein the source of gas includes sulfur or a sulfur containing compound.

22. The apparatus of claim 19, further comprising a gas distributor for fluidizing particles contained in the interior of the second vessel.

23. An apparatus for separating components of a mixture of particles, the apparatus comprising:

a vessel for containing the mixture of particles during processing, the vessel having a first end and a second end and an inlet located adjacent to the first end of the vessel that permits entry of the solid particles into the vessel;

a gas distributor disposed within the vessel for fluidizing the mixture of particles;

an energy system coupled to the vessel for exposing the mixture of particles to microwave/millimeter wave energy; and

a magnetic separator located adjacent the second end of the vessel for separating magnetic particles from non-magnetic particles.